MANUFACTURE OF THIN FILM MAGNETIC HEAD

Patent Number: JP63113812
Publication date: 1988-05-18

Inventor(s): MORIJIRI MAKOTO; others: 06
Applicant(s): HITACHI LTD

Requested Patent: JP63113812
Application Number: JP19860259198 19861030
Priority Number(s):
IPC Classification: G11B5/31; G11B5/17
EC Classification:
Equivalents: JP2588392B2

Abstract

PURPOSE:To raise the reliability, and also, to obtain the high density by forming a conductor coil by embedding a metallic film into the groove of an insulating film which is formed in advance, so that insulating layer can be filled exactly between coil wires.
CONSTITUTION:An insulating film 2 is formed by a prescribed film thickness on a substrate 1, and a photoresist pattern 3 is formed thereon. Subsequently, by using the photoresist pattern 3 as a mask material, a groove 20 is formed on the insulating film 2 by dry method. This groove 20 is the same pattern as a pattern of a conductor coil. Thereafter, the photoresist is eliminated by etching, and on the whole surface of the insulating film 2, a plating surface 4 is formed. A metallic film 5 which becomes the conductor coil is formed on its whole surface by a plating method, and thereafter, its whole surface is eliminated to the insulating layer formed part by an etch-back method, and a coil pattern is formed. In such a way, the metallic film 5 is formed in the groove 20 without filling a resin between the coils, thereafter, the generation of an air-foam, based on the fluidity failure of the resin can be prevented.

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　昭63-113812

⑤1Int.Cl.⁴	識別記号	庁内整理番号	⑬公開　昭和63年(1988)5月18日
G 11 B 5/31 5/17		F-7426-5D 6538-5D	

審査請求　未請求　発明の数 1　(全8頁)

⑤4発明の名称　薄膜磁気ヘッドの製造方法

⑳特　願　昭61-259198
㉒出　願　昭61(1986)10月30日

⑦2発明者　森　尻　　誠　茨城県日立市久慈町4026番地　株式会社日立製作所日立研究所内
⑦2発明者　原　　眞　一　茨城県日立市久慈町4026番地　株式会社日立製作所日立研究所内
⑦2発明者　芦　田　栄　次　茨城県日立市久慈町4026番地　株式会社日立製作所日立研究所内
⑦2発明者　川　辺　　隆　茨城県日立市久慈町4026番地　株式会社日立製作所日立研究所内
⑦1出願人　株式会社日立製作所　東京都千代田区神田駿河台4丁目6番地
⑦4代理人　弁理士　鵜沼　辰之　外1名
最終頁に続く

明　細　書

1．発明の名称

薄膜磁気ヘッドの製造方法

2．特許請求の範囲

1．基板上に絶縁膜を積層して形成し、所定形状の導体コルクが絶縁部を介して交互に所定間隔で配設されたパターンを有する導体コイルパターンを前記絶縁膜中に形成することによりなる薄膜磁気ヘッドの製造方法において、

あらかじめ前記絶縁膜に前記導体コイル形状に相当する溝を前記パターンと同一パターンで形成する溝パターン形成工程と、

前記導体コイルパターンのコイル相互間が絶縁されるように前記溝内に当該導体コイルとなる金属を充填して前記導体コイルパターンを形成するコイルパターン形成工程と、

当該導体コイルパターンを有する絶縁膜上に第2の絶縁膜を形成する絶縁膜形成工程と、

を備えてなることを特徴とする薄膜磁気ヘッドの製造方法。

2．特許請求の範囲第1項において、上記溝パターン形成工程における溝の中及び当該溝が設けられていない絶縁膜上に導体コイルとなる金属の膜を積層して形成し、次いで上記導体コイルパターンのコイル相互間が絶縁されるように、前記金属膜を切削またはエッチングして導体コイルパターンを形成することにより、

前記溝内に導体コイルとなる金属を充填して上記導体コイルパターンを形成することを特徴とする薄膜磁気ヘッドの製造方法。

3．特許請求の範囲第1項において、上記溝パターン形成工程における溝の形成を、上記絶縁膜上にフオトレジストのパターンを形成し、該フオトレジストパターンをマスク材にして、当該絶縁膜上に溝を形成することにより行うものであることを特徴とする薄膜磁気ヘッドの製造方法。

3．発明の詳細な説明

〔産業上の利用分野〕

本発明は薄膜磁気ヘッドの製造法に係り、特に

薄膜磁気ヘッドのコイル及び絶縁膜の形成に関する。

〔従来の技術〕

従来の磁気ディスク装置用薄膜磁気ヘッドは、日経エレクトロニクス、１９８０年７月７日号、１１０頁から１１１頁に記述されているように、導体コイルをめっき法により形成し、絶縁膜を、有機樹脂であるフォトレジストを熱硬化したもので形成している。このような磁気ディスク装置用薄膜磁気ヘッドにおいて、高密度磁気記録を達成するためには、限られた部分に高密度なコイルを形成する必要がある。コイルの高密度を達成するには、たとえば、多巻のコイルの各巻のスペース部の距離が２μｍ以下となるような微細な構造が必要である。この構成の場合、絶縁膜としてフォトレジストを硬化させたものを使用しているため、その樹脂の熱流動性等の性質により、コイル各巻間に形成されたスペース部に樹脂が充填され、薄膜磁気ヘッドが構成されている。

しかしながら、フォトレジストを硬化した膜は耐熱性が悪いという問題がある。

耐熱性を向上させた絶縁膜としてポリイミド系樹脂を用いた例が、アイ・イー・イー・イー，トランザクション　オン　マグネチックス、エムエージー１５，第１６１６頁～第１６１８頁（1979年）（ＩＥＥＥ Trans.Magn，ＭＡＧ－１５，１６１６～１６１８（１９７９））に示されている。

〔発明が解決しようとする問題点〕

しかし、本発明者らが検討したところ上記従来技術は、コイルの高密度化に対する配慮がされておらず、コイルのスペース間に気泡なく絶縁層であるポリイミド系樹脂を充填することは困難となる。樹脂の流動性が悪いためである。したがつて、充填残りによる絶縁層内の気泡により、磁気ヘッドの信頼性を低下するという問題があつた。

また、コイル及びコイル間に絶縁層を形成するため、形成した絶縁層の表面にコイルの段差を原因とする絶縁層の凹凸が生じ、そのままでは、その上部に形成する磁性膜の磁気特性の劣化を引き起こす。したがつて、上記従来技術では表面を平坦化する工程が必要となり、工程が複雑となるという問題がある。

本発明の目的は、コイル線間に絶縁層が確実に充填できることにより信頼性が高く、かつ、高密度化された薄膜磁気ヘッドを簡易な工程で製造することができる方法を提供することにある。

〔問題点を解決するための手段〕

上記目的を達成するために本発明は、基板上に絶縁膜を積層して形成し、所定形状の導体コイルが絶縁部を介して交互に所定間隔で配設されたパターンを有する導体コイルパターンを前記絶縁膜中に形成することによりなる薄膜磁気ヘッドの製造方法において、あらかじめ前記絶縁膜に前記導体コイル形状に相当する溝を前記パターンと同一パターンで形成する溝パターン形成工程と、前記導体コイルパターンのコイル相互間が絶縁されるように前記溝内に当該導体コイルとなる金属を充填して前記導体コイルパターンを形成するコイルパターン形成工程と、当該導体コイルパターンを有する絶縁膜上に第２の絶縁膜を形成する絶縁膜形成工程とを備えてなることを特徴とする薄膜磁気ヘッドの製造方法である。

〔作用〕

上記本発明によれば、あらかじめ形成してある絶縁膜の溝の中へ金属膜を埋め込んで導体コイルを形成することにより、コイル間の絶縁膜中に気泡のない薄膜磁気ヘッドを作成することができる。

また、導体コイルを形成した後、その上に絶縁膜を形成する場合に、その面を平坦化できるので、塗布した絶縁膜の表面の凹凸を小さくすることができ、次工程でその上に形成される磁性膜の特性を良好なものに保つことができる。

〔実施例〕

図面を用いて、本発明に係る実施例について説明する。第１図は、本発明における導体コイルの形成に関する工程の概略を示したものである。図においては、磁気ヘッドの断面図を示す。なお、説明上、基板上に形成されている磁性膜等は、図面上の基板１に含まれるものとし、導体コイル及

び導体コイルの埋め込まれる絶縁層を示してある。工程は次の順序に従う。

(1) 基板1上に絶縁膜2を所定膜厚形成する（第1図（1））。

(2) 絶縁膜2上にフオトレジストパターン3を形成する。この絶縁膜として有機樹脂又は無機膜を使用することができる（第1図（2））。

(3) フオトレジストパターン3をマスク材にしてドライ法で絶縁膜2上に溝20を形成する（第1図（3））。この溝は導体コイルのパターンと同一のパターンとなるように形成する。

フオトレジストとそのエツチングにより溝20を所望の形態（大きさ，高さ，厚さ等）にすることができる。機械的加工により溝20を形成することもできるが、それでは微細なパターンを形成する上で十分でない。よつて通常はエツチング加工が望ましい。

(4) フオトレジストをエツチング除去する（第1図（4））。

(5) 絶縁膜2表面全面にめつき下地膜4を形成する（第1図（5））。

(6) 全面にめつき法で導体コイルとなる金属膜5を形成する（第1図（6））。これにより、溝20中を含み絶縁膜上すべてに金属膜が形成されるとともに、その表面の凹凸は絶縁膜の凹凸に比較して小さくなり、平坦になる。全面に金属膜5を形成するのは、次の理由による。溝20内に限定して金属膜を形成することもできるが、それは通常難しい。そこで、後述するように全面に金属膜を形成し、この金属膜をいわゆるエツチバツク法により除去して、コイルパターンを形成するようにした。

(7) この全面をエツチバツク法で絶縁層形成部分まで除去する。かつ溝の上部に形成されている導体の接続部分を除去して各導体間が金属膜でつながつていないようにし、コイルパターンを形成する（第1図（7））。

(8) このようにして形成した導体コイル上に絶縁膜21を形成して、導体コイル形成工程を終了する（第1図（8））。

以上の工程によれば、めつきした金属膜間（コイル間）に樹脂を充填させず、溝20内に金属膜を形成しているために、樹脂の流動性不良に基づく気泡の巻き込み等を防止できる。

次に具体的な実施例について説明する。

第2図は、基板1上に絶縁膜2として有機樹脂であるポリイミド系樹脂を形成した実施例を示す（第2図（2））。ポリイミド系樹脂として、PIQ（ポリイミドイソインドロキナゾリンジオン　商品名，日立化成株式会社）を用いた。次いで、ドライ法を用いてコイルを形成する溝を形成する。ここで、ドライ法とは、プラズマエツチング法やイオンビームエツチング法などの手法があげられる。いずれの方法についても、溶液を用いてエツチングする化学エツチング法の場合よりもパターン幅を狭く、また、深く形成することができるので、高密度にコイルを形成することができるという特徴がある。

第2図（1）は、基板1上にPIQからなる絶縁膜を形成している。次に、（2）に示すようにフオトレジストパターン3を形成する。ここに用いられるフオトレジストとしては、パターン精度の良いことから、ノボラツク系ポジ型のフオトレジストであるマイクロポジツト1300（商品名，シプレイファースト株式会社）を使用することができるが、このフオトレジストパターンの断面形状では絶縁膜2表面に近い方が幅の広い台形になる。

このようにして形成したフオトレジストパターン3をマスクとして、ドライ法でPIQをエツチングする。この時のエツチング法としては、O_2ガスを用いたイオンビームエツチングがパターン精度が良く、安定してエツチングできる。この時、PIQ膜がエツチングされると同時にマスク材として用いられるフオトレジストもエツチングされるので、高さ及び幅が減少する（第2図（3））。フオトレジストもPIQも同時にエツチングされるので、フオトレジストの当初の膜厚を、絶縁膜の溝20の深さよりも厚く形成して、イオンビームエツチング後にもフオトレジストが絶縁膜2上

に残存させる膜厚とする。続いて、フオトレジスト２２だけをフオトレジスト剥離液で除去し、絶縁膜２上にコイルを形成する溝２０を形成する（第２図（４））。

この時、マスク材としてフオトレジストのみを使うと、エツチング中にフオトレジストの側壁も同時にエツチングされるため、絶縁膜２中の溝２０の断面形状は第２図（４）に示すようにテーパのついた形状となる。したがつて、高密度のコイルを形成するには困難である場合を生じる。すなわち、高密度コイルパターンを形成する場合は、隣接する溝どおしがつながつてしまうこともある。

そこで、絶縁膜の断面形状のテーパ角を立てることにより、高密度コイルを形成するためには、フオトレジストをマスクとするだけでなく、金属膜をマスクとして絶縁膜２をエツチングする方法が良い。第３図にその一例を示す。第３図（１）の絶縁膜上に金属膜１４を形成し、その上にフオトレジストパターン３を形成する。第３図（２）に示すようにこのフオトレジストパターンをマスクとして、最初にマスクとする金属膜１４をエツチングする。絶縁膜２をドライ法でエツチングする場合、有機膜であるＰＩＱをエツチングするための、O_2 ガスを用いたイオンビームエツチング法を用いることが、パターン精度を良くするために有効な方法である。この時のマスク材としての金属膜１４としては、耐酸素イオンビームエツチング性の高いクロム，モリブデン，ニツケル等，各種の金属を用いることができる。

このように金属膜パターンを形成した後、第３図（３）のようにO_2 ガスイオンビームエツチング法を用いて、絶縁膜に溝２０を形成し、その後、残存したフオトレジスト及びマスク材の金属膜を除去することにより、第３図（４）に示すように絶縁膜上に溝を形成する。

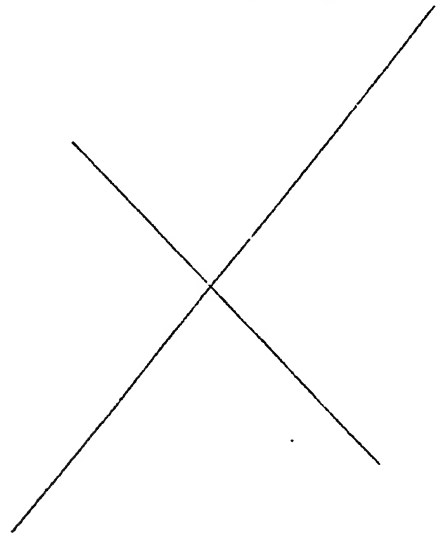
次に、第４図に示すように、ＰＩＱ上に形成された溝の中にコイルを形成する。

電気めつき法でコイルの金属膜を形成する方法について述べる。第４図（１）に示すように、溝を形成したＰＩＱから絶縁膜上全面にめつき下地膜４を形成する。

めっき下地膜はＰＩＱと、導体コイルとなる金属膜との密着性が悪いため、金属膜をめっき下地膜を介してＰＩＱに接着させるために設けるものである。このめっき下地膜は、例えば、ＣｒをＰＩＱ（基板）上に蒸着法である例えばスパッタリング法を用いて蒸着し、続いて、ＣｕをＣｒの上に蒸着法である例えばスパッタリング法を用いて蒸着することにより形成する。この時Ｃｒは、ＰＩＱとＣｕとを接着させ、また、ＣｕはＣｒと導体コイルとなる金属膜とを接着させるためのものである。めっき下地膜の内、前者のものとして、Ｃｒの他、Ｔｉ，Ｎｉ，Ｍｏ，Ｔａ等を用いることができる。また、めっき下地膜の内、後者のものとして、Ｃｕの他、Ｎｉ，Ａｕ等を用いることができる。

この下地膜上の導体金属例えばＣｕを電気めつきする。Ｃｕの他、Ａｕ，Ｎｉであっても良い。

金属膜５形成の時、このめつき膜４（Ｃｕ膜）のつきまわりによりＰＩＱの溝２０の段差に比較してめつき膜表面５の凹凸を小さくすることができる。次に、このめつき膜全体をエッチバックする。すなわち、第４図（３）に示すように、絶縁層表面２３が現われるまで金属全面をエッチングし、コイルの相互間が絶縁され、また、表面が平坦化されるようにする。最後にＰＩＱ膜を表面に形成し、コイルパターンの形成を終わる。この時、



コイル上面の絶縁膜２３との間が平坦化されているので、上層に形成したＰＩＱの表面は平坦に形成され、後工程でその上に形成される磁性膜の磁気特性の劣化を防止することができる。

第４図（３）に示したエッチバック法について以下に説明する。

ドライ法によるエッチバックとしては、スパッタエッチング法あるいは、イオンビームエッチング法が用いられる。エッチバック法は、第４図に説明したように、金属膜表面を平坦になるまで形成した上で、全面をエッチングして後退させることである。しかしながら、金属膜５表面が平坦になるまで金属膜を形成するには、金属膜を厚く形成する必要がある。金属膜を厚くしないですむ方法としては、第５図に示す方法がある。すなわち第５図（１）に示すように金属膜５表面の凹凸があっても、その上に流動性の良い有機樹脂１７を被層形成して、第５図（２）に示すように全面を平坦化し、その後、全面をエッチバックすることにより第５図（３）に示すように絶縁膜に埋め込まれたコイルの表面を平坦に作ることができる。この時、塗布した有機樹脂の平坦性をそのままコイル形成まで転写するには、有機樹脂と金属膜とのエッチング速度を同等にすることが良い。

例えば、金属膜としてＣｕを用い、絶縁膜としてＰＩＱを用いたエッチング速度について説明する。第６図には、イオンビームエッチング法、反応ガスとしてアルゴンと酸素の混合ガスを用いた場合のＣｕとＰＩＱのエッチング速度の差を示す。

第６図によれば、酸素量が増すに従い、ＰＩＱのエッチング速度が増加し、Ｃｕのエッチング速度が低下して、ＣｕとＰＩＱのエッチング速度とを一定とすることができる。このような条件を選定することにより、エッチバック後の表面を平坦にすることができる。

エッチバック法以外の他の方法として、機械的に研摩する方法も考えることができる。例えば、第７図（１）に示すように、表面の凹凸のある金属面でも、基板表面を研摩することにより、第７図（２）に示すように金属膜表面を平坦にでき、さらに第７図（３）に示すように、絶縁膜２３が表面に現われるまで研摩することにより、コイルパターン２４を完成することができる。この方法によれば、ドライ法等の真空装置を用いることによる工程数の増加及び製造コスト高をさけることができるという効果がある。

以上述べた本実施例では、絶縁膜２として有機樹脂を用いた例を述べたが、同様に溝を形成するエッチング条件及びエッチバックに用いられるエッチング方法を選定することにより無機膜を用いることができる。

第４図に示したように、金属膜５の形成法としては電気めっき法を用いたが、他の方法も可能である。例えば、第８図に示すように、化学めっき法で金属膜５を形成して、導体コイル２４を形成することが可能である。

第８図（１）に示すように、溝２０を形成した絶縁膜２の表面全体に化学めっき膜を形成するための活性化処理をほどこす。この処理の一例を次に示す。

$SnCl_2 \cdot 2H_2O$	４０ｇ／ℓ
ＨＣℓ	２０ｍℓ／ℓ

の溶液に２分間浸した後、

$PdCl_2 \cdot 2H_2O$	０．４ｇ／ℓ
ＨＣℓ	４ｍℓ／ℓ

の溶液に２分間浸すことにより、絶縁膜２の表面全面にＰｄ２５を析出させる。ここでは、Ｐｄを析出させる活性化処理をしたが、他にＡｕ，Ａｇ，Ｐｔなどの金属を用いることができる。

このようにして活性化処理をほどこした基板を化学銅めっき液中に浸すことにより、活性化処理のほどこされた絶縁膜表面全面に銅めっき膜５を形成することが可能である。もちろん化学銅めっきだけでなく、化学めっきできる金属であれば、銅に限らず金，ニッケル等のどんな金属を用いることも可能である。

この方法によれば、電気めっきのように基板上に電気を与えるための端子を形成する必要がなく活性化処理をすれば、どんな部分にでも導体コイルを形成することが可能である。

また、他の方法として、前記したとおり、真空蒸着法やスパッタリング法を用いる方法がある。この方法を用いた場合、絶縁膜表面の凹凸は、上記しためっき法の場合のようには小さくならないので、エッチバック法としては、第5図で示したように有機樹脂で平坦化する方法を採ることが望ましい。

〔発明の効果〕

本発明によれば、薄膜磁気ヘッドの高密度の導体コイルを形成する際に、絶縁膜中にコイル間に気泡が取り込まれるのを防止することによる磁気ヘッドの信頼性の低下を防止することによって、磁気ヘッドの信頼性の低下を防止することができる。さらに、コイル上に形成する絶縁膜の表面の凹凸をも小さくすることができるので、後工程でその上に形成する磁性膜の磁気特性の劣化を防止するとともに、薄膜磁気ヘッドの特性の向上と信頼性の向上を達成できるという効果を有する。

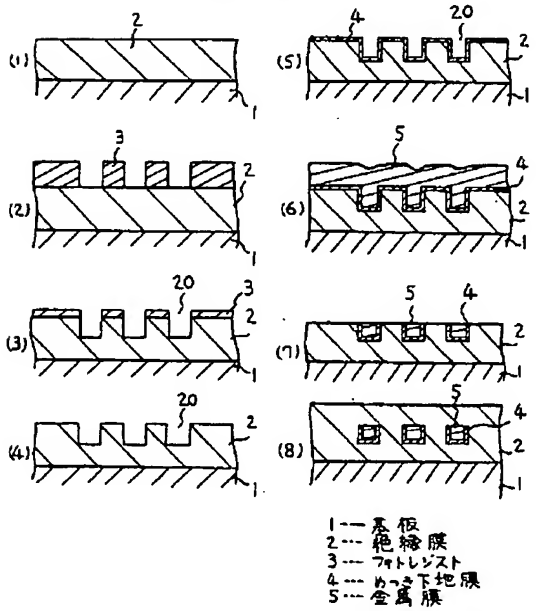
4．図面の簡単な説明

第1図は本発明にかかる薄膜磁気ヘッドの製造方法の一実施例を示す概略工程図、第2図ないし第5図は本発明にかかる薄膜磁気ヘッドの製造方法の具体的実施例を示す工程図、第6図は$Ar-O_2$の混合割合と絶縁膜のエッチング速度との関係を示すグラフ、第7図は本発明にかかる薄膜磁気ヘッドの製造方法の具体的実施例を示す工程図、第8図は他の具体的実施例を示す工程図である。

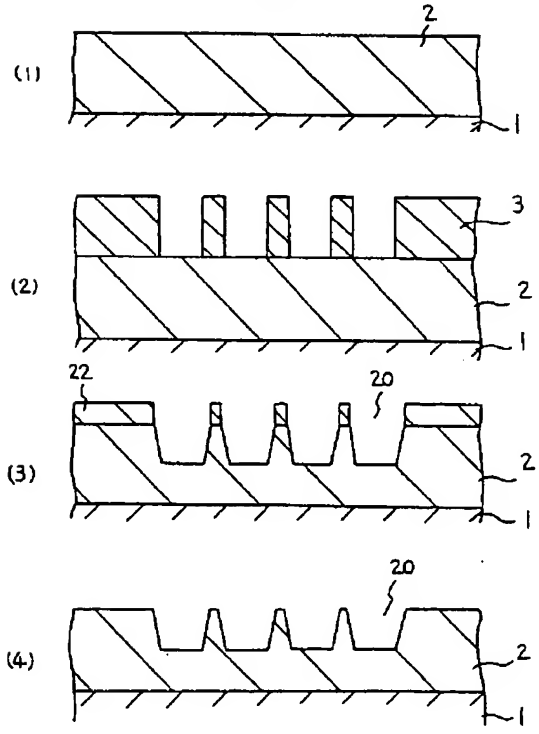
1…基板、2…絶縁膜、3…フォトレジスト、4…めっき下地膜、5…金属膜。

代理人　弁理士　鈴江武彦

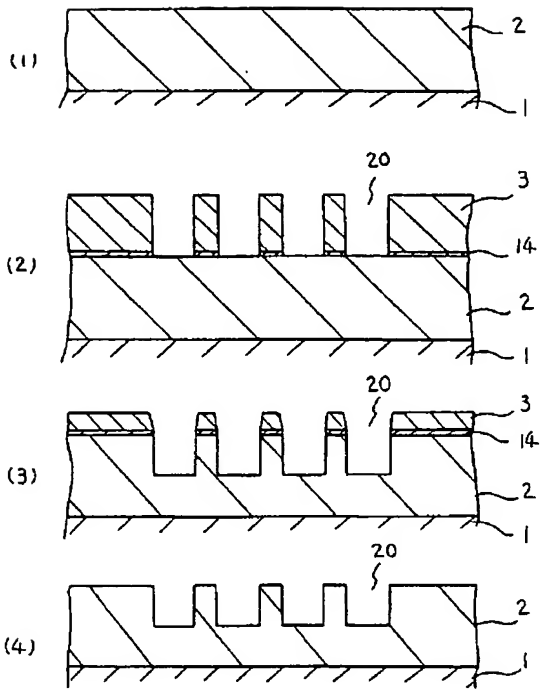
第1図



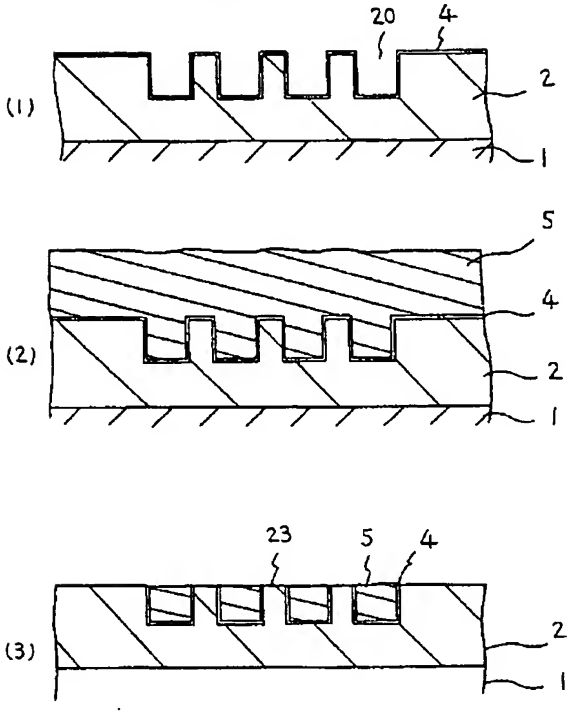
第2図



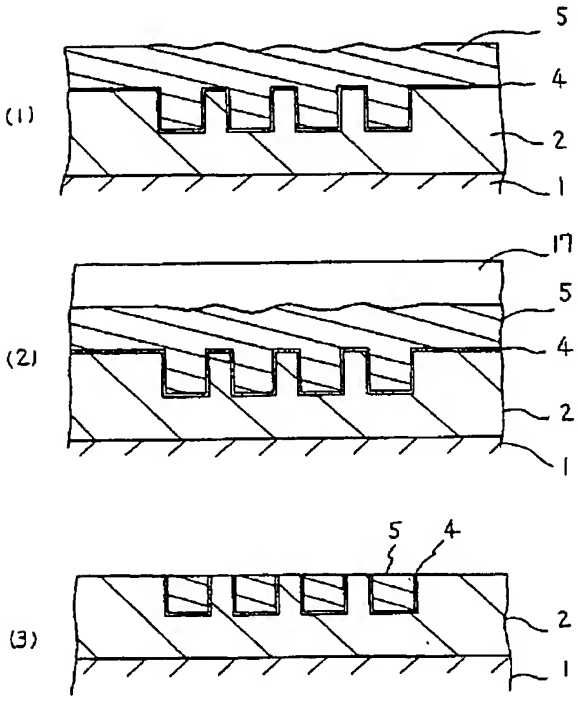
第3図



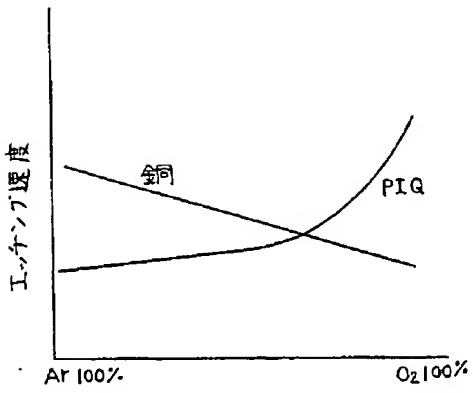
第4図



第5図



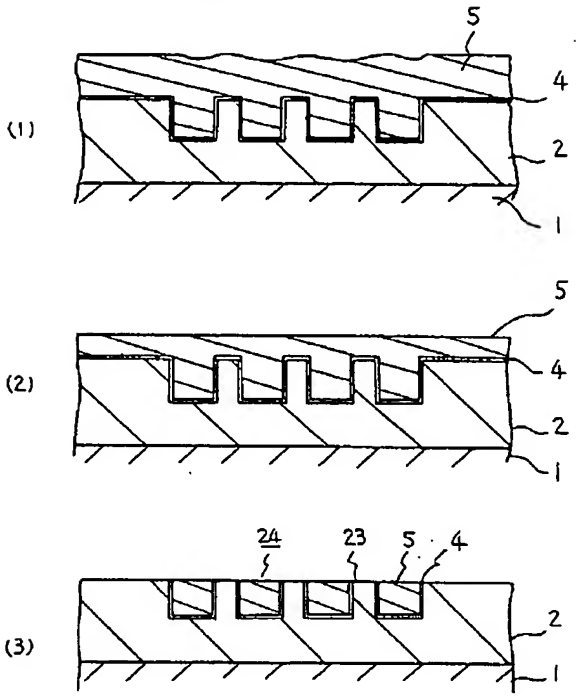
第6図



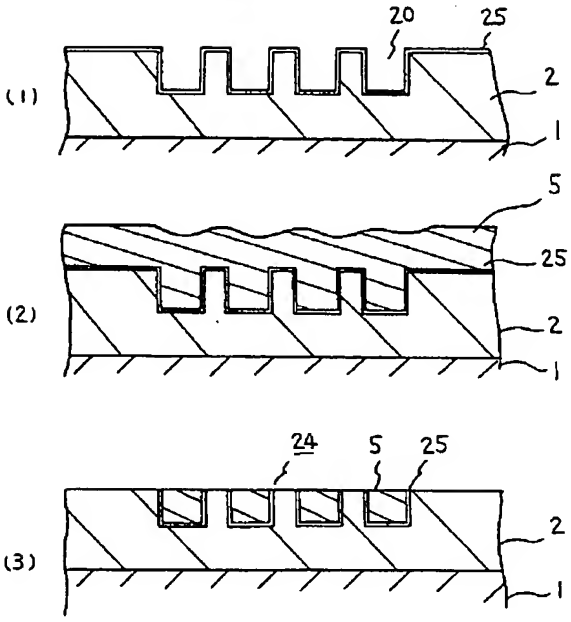
Ar-O₂の混合割合

反応ガスの混合割合と銅とPIQのエッチング速度の関係

第7図



第8図



第1頁の続き

⑫発明者 吉成 恒男 茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

⑫発明者 華園 雅信 茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

⑫発明者 鈴木 三郎 神奈川県小田原市国府津2880番地 株式会社日立製作所小田原工場内

Machine Translation of JP 2588392 B2 (equiv. 63-113812 A)

Detailed description of the invention. The this 〔 the utilization field on the industry 〕 invention concerns the production technique of a thin film magnetism ヘツド, and especially, the formation of coil and insulating film of a thin film magnetism ヘツド is concerned. A thin film magnetism ヘツド for the magnetism デイスク equipment in 〔 conventional technology 〕 convention forms the conductor coil by the め method in order to describe from day sutra electronics, July seventh, 1980, 110 pages to 111 pages, and it has been formed in the result of doing heat curing of フオトレジスト which the insulating film was organic resin. It is necessary to form the high-density coil at limited part it achieves the high-density magnetic recording in such thin film magnetism ヘツド for the magnetism デイスク equipment. The minute structure in which for example, the distance of the space division of each volume of the multivolume coil becomes 2 μm or less is necessary in order to achieve the high density of the coil.

In case of this composition, since the result of stiffening フオトレジスト as an insulating film is used, the resin is filled in space division formed between each coil volume by property such as the resinoid heat flow kinesis, and a thin film magnetism ヘツド is constituted. However, there is a problem with the bad heat-resistance on the film which stiffened フオトレジスト. Examples using the polyimide system resin are eye イー イー, トランザクシヨンオンマグネチツクス, エムエージー 15, 1616th page ～ 1618th page as an insulating film in which the heat-resistance is improved (1979). (IEEE Trans. Magn, MAG－15, 1616～1618 (1979)) ＜＜Unparseable Text＞＞ It becomes the difficulty that the technology fills the polyimide system resin that there is no bubble between space of the coil and that it is an insulating layer without doing the consideration for the densifying of the coil, when however, this inventors examined it 〔 the problem in which the invention intends to reach solution 〕, superscription convention,. The resinoid fluidity is due to be bad. Though it was done, by introducer and bubble in the insulating layer by the filling remainder, the problem of lowering the reliability of magnetism ヘツド is あつた. And, that it comes out as it is in order to form the insulating layer in coil and between coils, the ruggedness of the insulating layer which makes level difference of the coil to be causing on the surface of formed insulating layer, occurs, and the degradation of the magnetic characteristic of magnetic film besides, it forms at the department

is caused. Though it was done, the process of flattening the surface in the technology introducer superscription convention is required, and there is a problem that the process becomes the complexity. The purpose of this invention is to offer the method in which that the reliability is high by the insulating layer surely filling between coil lines, and again, that it produces got thin film magnetism ヘツド by the simple process is possible. Aforesaid フォトレジス this invention forms the insulating film on the substrate in order to achieve 〔 means for solving the problem 〕 superscription purpose, and the photoresist of conductor coil of the fixed shape and identical pattern is formed on the aforesaid insulating film, and the aforesaid photoresist is made to be the mask material, the groove of aforesaid conductor coil and identical pattern is formed on this insulating film by the dry etching method. ト is removed, and metal film is formed by the plating in the full face on aforesaid insulating film of the aforesaid groove, and the conductor coil of the fixed shape is formed in the groove by the removal of the metal film except for the groove in respect of the surface of the aforesaid metal film, and it is the production technique of thin film magnetic head which forms the second insulating film on aforesaid insulating film with the this conductor coil. According to the this 〔 action 〕 invention, after the groove of conductor coil and identical pattern was formed on the insulating film, the photoresist is removed, and metal film is formed by the plating in the full face on aforesaid insulating film of this groove. Afterwards, it is possible that it removes the metal film except for the groove by polishing the surface of the metal film by etchback methods, etc., and simply makes the thin film magnetic head in which therefore, there is no bubble in insulating film between coils this fixed conductor coil would, while the surface is flattened. Of the in addition, magnetic film in forming the second insulating film in the insulating film surface, after the conductor coil is formed, because to easily flatten the surface by the removal of metal film except for the groove is possible, that that the surface of apply second insulating film is also made to be the flat surface where there is hardly the ruggedness is possible and that it forms it by the next process in the top. It is possible to keep characteristics to the good thing. Using 〔 practical example 〕 drawing, practical example which concerns this invention is explained. The first figure showed the summary of the process on the formation of the conductor coil in this invention. In the figure, the sectional-view of magnetism ヘツド is shown. Still, magnetic film formed on the description and substrate, etc. was supposed to be included for

substrate of 1 on the drawing, and it showed the insulating layer that conductor coil and conductor coil were embedded. The process follows next order. (1) Insulating film of 2 are formed on substrate of 1 at the fixed film thickness (first figure (1)). (2) フオトレジストパターン 3 are formed on insulating films of 2. It is possible to use organic resin or inorganic film as this insulating film (first figure (2)). In making (3) フオトレジストパターン3 to be the mask material, grooves of 20 is formed on insulating films of 2 by the dry-method (first figure (3)). It is formed so that this groove may become a pattern which is identical with the pattern of the conductor coil. It is possible to make grooves of 20 to be a form (size, height, thickness, etc.) of the desire by フオトレジスト and the エツチング. Though it is also possible mechanical grooves 20, in it, it is not sufficient, when the minuteness forms the pattern. The エツチング processing is desirable generally よ introducer. (4) フオトレジスト is removed in the peeling liquid (first figure (4)). (5) Backing film 4 with め are formed in insulating film 2 surfaces full face (first figure (5)). (6) Metal films of 5 which become the full face by the め method with the conductor coil are formed (first figure (6)). By this, the ruggedness of the surface becomes small in comparison with the ruggedness of the insulating film with forming the metal film of grooves of 20 in all on insulating film, and is flattened. It is based that metal film of 5 are formed in the full face on next reason. Though it is also possible grooves 20 metal film, it is difficult generally. Then, metal film was formed in the full face in order to describe later, and the coil pattern would be formed by the removal of this metal film by what is called エツチバツク method. (7) This full face is removed to the insulating layer formation part in エツチバツク. Again, by the removal of the junction minute of the conductor formed in the upper part in the groove, each between conductors connect it in the metal film, and there would not be an introducer, and the coil pattern is formed (first figure (7)). (8) The conductor coil making process is finished by the formation of insulating films of 21 (first figure (8)). Entrainments of the bubble based on the resinoid fluidity bad, etc. can be prevented, since according to the above process, しed between metal films (between coils) do not fill the resin in め つき, and since it has formed the metal film in grooves of 20. The next concrete practical example is explained. The second figure shows the practical example which formed polyimide system resin which is organic resin on substrate of 1 as insulating film of 2 (second figure (2)). As a polyimide system resin, PIQ (polyimide

isoindolo quinazolinedione trade name, HITACHI formation Co.,Ltd.) was used. Next, the groove which forms the coil using the dry-method is formed. Techniques such as プラズマエツチング method and イオンビームエツチング method are raised dry-methods here. On either method, the pattern width is also also narrowed further than the case of chemistry エツチング method done エツチング using the solution, and it is unique that that the coil is formed in the high density, because to form and, deeply is possible, is possible. Second figure (1) has formed the insulating film which changes from PIQ on substrate of 1. Next, フオトレジストパターン 3 are formed, as it is shown in (2). Thereupon, as used フオトレジスト, in the cross-sectional shape of this フオトレジストパターン, because the pattern accuracy is good, it is possible to use マイクロポジツト 1300 (trade name, ジプレイフアーストCo.,Ltd.) which are ノボラツク system positive フオトレジスト, and it becomes a trapezoid in which it is wide the width of that it is close to insulating film of 2 surfaces. In making to be masking フオトレジストパターン 3 formed by doing like this, エツチング of PIQ is done by the dry-method. As this time エツチング method, by stabilizing the pattern accuracy well, イオンビームエツチング using the 02 gas is possible エツチング. This time, height and width decrease, because エツチング of フオトレジスト used as a mask material is also done on doing エツチング of a PIQ film, (second figure (3)). By forming the film thickness in the beginning of フオトレジスト than the depth of insulating film of grooves of 20, because simultaneously, エツチング of フオトレジスト and PIQ is also done, deeply, it is made to be the film thickness in which フオトレジスト also is made to remain after イオンビームエツチング on insulating film of 2. It continues, only フオトレジスト 22 are removed in the フオトレジスト peeling liquid, and grooves of 20 which forms the coil on insulating films of 2 is formed (second figure (4)). This time, it becomes a shape in which the taper was given, as the cross-sectional shape in insulating film of 2 of groove of 20 is shown in second figure (4), when only フオトレジスト is used as a mask material, since simultaneously, エツチング of the sidewall of フオトレジスト is done in エツチング.

It was done, and it 生ずるs in order to form introducer and high-density coil, difficult 。 that is to say, つなぐing つて adjoining groove どおし also has こと, when the high-density coil pattern is formed, しまう. Then, by making the taper angle of the cross-sectional shape of insulating film, in order to form the high-density coil, it is made to be masking the metal film フオトレジスト, and the method for doing エツチング of insulating

films of 2 is good. The example is shown in the third figure. Metal film of 14 are formed on the insulating film of third figure (1), and フオトレジストパターン 3 are formed in the top. In making to be masking this フオトレジストパターン, as it is shown in third figure (2), first エツチング of metal films of 14 as a mask is done. It is the method in which to use イオンビームエツチング method using the O2 gas for doing エツチング of PIQ which is the organic film, when エツチング of insulating films of 2 is done by the dry-method, is effective in order to improve the pattern accuracy. As metal films of 14 as this time mask material, it is possible to use various metals such as chromium, molybdenum, ニツケル of which acidproof element イオンビームエツチング-ness is high. The groove is formed on the insulating film, as it is shown by by using O2 ガスイオンビームエツチング method like third figure (3) after it formed the metal film pattern like this, it forms grooves of 20 in insulating film, and removing remained フオトレジスト and metal film of the mask material afterwards in third figure (4). Next, the coil is formed in the groove formed on PIQ, as it is shown in the fourth figure. The method for forming the metal film of the coil by the electricity め method is described. Backing film of 4 with め is formed from PIQ which formed the groove in the full face on insulating film, as it is shown in fourth figure (1). A backing film with め is established, and the adhesion between PIQ and metal film as a conductor coil is bad, and the metal film is made to bond together through a plating backing film in PIQ. This plating backing film is formed by for example, it deposits using the sputtering technique for example, Cr PIQ (substrate) evaporation method, and for example, it deposits using the sputtering technique next, Cu Cr evaporation method. Cu PIQ is bonded together by Cr with Cu this time, and and, it is for bonding Cr together with the metal film as a conductor coil. It is possible to use besides besides former Cr as a thing within a plating backing film Ti,Ni,Mo,Ta, etc.. And, it is possible to use besides besides Cu Ni,Au, etc. within a plating backing film as a result with latter. Conductor metal on this plating backing film, for example electricity め つき of Cu, is done. It may be besides besides Cu Au,Ni. It is possible to make the ruggedness of the surface metal films of 5, namely metal film of 5 in plating film formation by attachment circumference of this film (a Cu film) with め compared to the level difference of PIQ of grooves of 20, small. Next, the etchback of this whole film with め is done. That is to say, the metal full face is etched, as it is shown in fourth figure (3), until insulating layer surface of 23 appears, and the mutual relation of the coil is insulated, and the surface

would be flattened. Finally, a PIQ film is formed on the surface, and it ends in respect of the formation of the coil pattern. This time, the surface of PIQ formed in the upper part is flatly formed, because the interval between coil upper surface and insulating layer surface of 23 is flattened, and it is possible to prevent the degradation of the magnetic characteristic of magnetic film formed by the post-process in the top. エツチバツク method shown in fourth figure (3) is explained in the following. As エツチバツク by the dry-method, スパツタエツチング method or イオンビームエツチング method are used. The エツチバツグ method is to decline by doing エツチング of the full face, when the metal film surface was formed, until it is flattened, as it explained in the fourth figure. However, it is necessary to form the metal film deeply in order to form the metal film, until metal film of 5 surfaces are flattened. As the method that does not thicken and pays the metal film, there is a method for showing in the fifth figure. That is to say, the ruggedness of metal film of 5 surfaces is possible to flatly make the surface of the coil embedded in the insulating film, as it is shown by flattening the full face in order to show in fifth figure (2), in making organic resin of 17 of which the fluidity is also good for the top on あ つて, as it is shown in fifth figure (1), layered, and doing エツチバツク of the full face afterwards in fifth figure (3). This time, it is good that the エツチング speed between organic resin and metal film is done equivalent in order to copy the flatness of applied organic resin as it is to the coil making. For example, the エツチング speed using PIQ is explained using Cu as a metal film as insulating film. In the sixth figure, the difference in argon and Cu in using the mixed gas of the oxygen and エツチング speed of PIQ is shown as イオンビームエツチング method, reactant gas. According to the sixth figure, it is possible that the エツチング speed of PIQ increases, as the oxygen content increases, and that it does it with that it is constant in respect of Cu and エツチング speed of PIQ by the エツチング speed of Cu lowering. By selecting such condition, it is possible to flatten the surface after エツチバツク. As a method besides the except for エツチバツク method, it is possible to also consider the method for mechanically polishing. For example, the metal film surface can be flattened, as it is shown by polishing the substrate surface even in the metal surface with the ruggedness of the surface, as it is shown in seventh figure (1), in seventh figure (2), and it is possible to complete conductor coil of 24 by polishing, until insulating layer surface of 23 appears, as in addition, it is shown in seventh figure (3). According to this method, it is effective that to

avoid increase and manufacturing cost high of the process number by using vacuum devices such as the dry-method, is possible. Though in this practical example which described the above, the example using organic resin was described as insulating film of 2, it is possible to use the inorganic film by selecting エツチング condition for similarly forming the groove and エツチング method for エツチバツク. Though the electricity め method was used as a formation method of metal film of 5, as it was shown in the fourth figure, other method is also possible. For example, it is possible that conductor coil of 24 is formed by forming metal films of 5 by the chemistry め method, as it is shown in the eighth figure. The activation for forming a film with chemistry め in whole surface of insulating films of 2 which formed grooves of 20, as it is shown in eighth figure (1), is conducted. Next example of this processing will be shown. SnCl2・2H2O 40g/■HCl PdCl2・2H2O it was soaked in 20ml/■ solution during halves 0.4g/■HCl Surface full face of insulating films of 2 is made to deposit Pd25 by soaking in 4ml/■ solution during halves. Here, though the activation which deposited Pd was done, it is possible to use metals such as Au, Ag, Pt otherwise. By soaking the substrate which conducted the activation by doing like this, in submerged with chemistry copper め, it is possible to form film of 5 with copper め in insulating film surface full face that the activation was conducted. It is also possible to use gold it limits limit and what kind of metals such as ニツケル for the copper, if it is the metal which is not only chemistry copper め つき of course but also chemistry め つき.

According to this method, it is possible that that it comes out at what kind of part, if it does not need to form the terminal to for give the electricity on the substrate like electricity め つき, and if the activation is done, also forms the conductor coil. And, there is a method using vacuum deposition formula and スパツタリング method as other method, when it was written in advance. It is desirable that the method to for flatten in the organic resin is taken, as it was shown in the fifth figure as a エツチバツク method, because it does not decrease like the case in which this method was used and case of the method the ruggedness of the insulating film surface 溜める. According to the this 〔 effect of the invention 〕 invention, it is possible to prevent the lowering of the reliability of magnetism ヘツド and よ introducer in preventing that the bubble is taken in in the insulating film between coils, when high-density conductor coil of a thin film magnetism ヘツド is formed,. In addition, it has the effect that the characteristic improvement of a thin film magnetism ヘツド in

which that the degradation of the magnetic characteristic of magnetic film formed in the top is prevented possibly got dense and improvement in the reliability can be achieved by the post-process by the simple process, because to also make the ruggedness of the surface of the insulating film formed on the coil small is possible. 4·チ ·

Machine Translation of JP 2588392

DETAILED DESCRIPTION

[Detailed Description of the Invention] [Industrial Application] this invention relates to the manufacture method of the thin film magnetic head, especially relates to the coil of the thin film magnetic head, and formation of an insulator layer. [Description of the Prior Art] the conventional thin film magnetic head for magnetic disk units is described by 111 pages from the Nikkei electronics, the July 7, 1980 issue, and 110 pages -- as -- a conductor -- a coil is formed by the galvanizing method, it is what heat-hardened and the photoresist which is an organic resin about an insulator layer is formed In such the thin film magnetic head for magnetic disk units, in order to attain high-density magnetic recording, it is necessary to form a high-density coil in the limited portion. In order to attain the high density of a coil, the detailed structure where the distance of the space section of each volume of the coil of many volumes is set to 2 micrometers or less is required. Since what stiffened the photoresist as an insulator layer is used in this composition, the space section formed between coil each volume is filled up with a resin by properties, such as the heat flow rate kinesis of the resin, and the thin film magnetic head is constituted. However, the film which hardened the photoresist has the problem that thermal resistance is bad. The example using the polyimide system resin as an insulator layer which raised thermal resistance is IEEE and a transaction. ON It is shown in MAGUNECHITSUKUSU, em EJI 15, and 1616th page - the 1618th page (IEEE Trans.Magn, MAG-15, 1616-1618 (1979)) (1979). [Problem(s) to be Solved by the Invention] However, when this invention persons inquire, consideration of as opposed to the densification of a coil in the above-mentioned conventional technology is not carried out, but it becomes difficult to be filled up with the polyimide system resin which is an insulating layer that there is no foam between the spaces of a coil. It is because the fluidity of a resin is bad. Therefore, the problem of falling the reliability of the magnetic head with the foam in the insulating layer by the restoration remainder is ******. Moreover, in order to form an insulating layer between coils, the irregularity of the insulating layer which considers the level difference of a coil as a cause arises on the front face of the formed insulating layer, and if it remains as it is, degradation of the magnetic properties of the magnetic film formed in the upper part is caused. Therefore, with the above-mentioned conventional technology, the process which carries out flattening of the front face is needed, and there is a problem that a process becomes complicated. When an insulating layer can be certainly filled up between coil lines, the purpose of this invention is reliable and is to offer the method that the thin film magnetic head by which densification was carried out can be manufactured at a simple process. [The means for solving a technical problem] The photoresist of the same pattern as a coil is formed. in order to attain the above-mentioned purpose -- this invention -- a substrate top -- an insulator layer -- forming -- the aforementioned insulator layer top -- the conductor of a predetermined configuration -- The slot of the same pattern as a coil is formed. the aforementioned photoresist -- mask material -- carrying out -- the dry etching method -- the insulator layer top concerned -- the above -- a conductor -- Remove the aforementioned photoresist and a metal membrane is formed by the galvanizing method the whole surface on the aforementioned insulator layer including

aforementioned Mizouchi. the front face of the aforementioned metal membrane -- the etchback method or grinding mechanically -- metal membranes other than Mizouchi -- removing -- Mizouchi -- the conductor of a predetermined configuration -- a coil -- forming -- the conductor concerned -- it is the manufacture method of the thin film magnetic head which forms the 2nd insulator layer on the aforementioned insulator layer which has a coil [Function] according to this invention -- an insulator layer top -- a conductor -- after forming the slot of the same pattern as a coil, a photoresist is removed and a metal membrane is formed by the galvanizing method the whole surface on the aforementioned insulator layer including the Mizouchi concerned then -- while removing metal membranes other than Mizouchi and carrying out flattening of the front face by grinding the front face of the metal membrane by the etchback method etc. -- the Mizouchi concerned -- the conductor of a predetermined configuration -- a coil is formed, therefore the thin film magnetic head which does not have a foam into the insulator layer between coils can be created easily furthermore -- since metal membranes other than Mizouchi can be removed and flattening of the front face can be easily carried out by grinding by the etchback method etc. -- a conductor -- the front face of the 2nd insulator layer applied [after forming a coil] for forming the 2nd insulator layer in the insulator layer front face can also be used as the flat front face which does not almost have irregularity, and can maintain at a good thing the property of the magnetic film formed on it at the following process [Example] The example concerning this invention is explained using a drawing. a conductor [in / this invention / in a view 1] -- the outline of the process about formation of a coil is shown The cross section of the magnetic head is shown in drawing. in addition -- that by which the magnetic film currently formed on explanation and the substrate is contained in the substrate 1 on a drawing -- carrying out -- a conductor -- a coil and a conductor -- the insulating layer where a coil is embedded is shown A process follows in the following order. (1) Carry out predetermined thickness formation of the insulator layer 2 on a substrate 1 (view 1 (1)). (2) Form the photoresist pattern 3 on an insulator layer 2. An organic resin or an inorganic film can be used as this insulator layer (view 1 (2)). (3) Make the photoresist pattern 3 into mask material, and form a slot 20 on an insulator layer 2 by the dry method (view 1 (3)). this slot -- a conductor -- it forms so that it may become the pattern of a coil, and the same pattern A slot 20 can be made into desired gestalten (a size, height, thickness, etc.) by the photoresist and its etching. Although a slot 20 can also be formed by mechanical processing, it is not enough when forming a detailed ** pattern then. Therefore, etching processing is usually desirable. (4) Ablation liquid removes a photoresist (view 1 (4)). (5) Form the plating ground film 4 all over insulator layer 2 front face (view 1 (5)). (6) the whole surface -- the galvanizing method -- a conductor -- form the metal membrane 5 used as a coil (view 1 (6)) Thereby, while a metal membrane is formed [be / under / slot 20 / implication / it] in all on an insulator layer, the irregularity of the front face becomes small as compared with the irregularity of an insulator layer, and becomes flat. Forming a metal membrane 5 in the whole surface is based on the following reason. Although it can limit in a slot 20 and a metal membrane can also be formed, it is usually difficult. Then, the metal membrane was formed in the whole surface so that it might mention later, this metal membrane is removed by the so-called etchback method, and the coil pattern was formed. (7) Remove this whole surface to an insulating stratification portion by etchback. a part for and the connection of the conductor currently formed in the upper part of a slot -- removing -- each -- a conductor -- between -- a metal membrane -- a rope -- ****** -- there is

nothing -- making -- a coil pattern is formed (view 1 (7)) (8) the conductor which carried out in this way and was formed -- a coil top -- an insulator layer 21 -- forming -- a conductor -- end a coil formation process (view 1 (8)) Since according to the above process you do not make it filled up with a resin between the galvanized metal membranes (between coils) but the metal membrane is formed in a slot 20, the contamination of a foam based on the fluid defect of a resin etc. can be prevented. Next, a concrete example is explained. A view 2 shows the example in which the polyimide system resin which is an organic resin as an insulator layer 2 was formed on the substrate 1 (view 2 (2)). As a polyimide system resin, PIQ (a polyimide ISOINDORO quinazoline dione tradename and Hitachi Chemical Co., Ltd.) was used. Subsequently, the slot which forms a coil using the dry method is formed. Here, with the dry method, technique, such as the plasma etching method and the ion-beam-etching method, is raised. Since pattern width of face can be narrowly formed deeply rather than the case of the chemical etching method which **********s also about which method using a solution, there is the feature that a coil can be formed with high density. The view 2 (1) forms the insulator layer which consists of PIQ on a substrate 1. Next, as shown in (2), the photoresist pattern 3 is formed. Since pattern precision is good, although micro POJITSUTO 1300 (a tradename, JIPUREI fast incorporated company) which is the photoresist of a novolak system positive type can be used as a photoresist used here, in the cross-section configuration of this photoresist pattern, the direction near insulator layer 2 front face becomes the latus trapezoid of width of face. Thus, PIQ is **********ed by the dry method by using the formed photoresist pattern 3 as a mask. The ion beam etching using O2 gas as a method of etching at this time has a good pattern precision, and can stabilize and etch. Since the photoresist used as mask material at the same time a PIQ film **********s at this time also **********s, height and width of face decrease (view 2 (3)). Since it **********s simultaneously, a photoresist and PIQ form the original thickness of a photoresist more thickly than the depth of the slot 20 on the insulator layer, and make it the thickness which a photoresist makes remain on an insulator layer 2 also after ion beam etching. Then, photoresist ablation liquid removes only a photoresist 22 and the slot 20 which forms a coil on an insulator layer 2 is formed (view 2 (4)). If only a photoresist is used as mask material at this time, it will become the configuration where the taper also attached the side attachment wall of a photoresist during etching as the cross-section configuration of the slot 20 in an insulator layer 2 was shown in a view 2 (4) since it **********ed simultaneously. Therefore, the case of being difficult for forming a high-density coil is produced. That is, when forming a high-density coil pattern, adjoining slot entirety also has [a rope] intermediary striped ******. Then, in order to form a high-density coil by standing the taper angle of the cross-section configuration of an insulator layer, the method of it not only using a photoresist as a mask, but **********ing an insulator layer 2 by using a metal membrane as a mask is good. The example is shown in a view 3. A metal membrane 14 is formed on the insulator layer of a view 3 (1), and the photoresist pattern 3 is formed on it. The metal membrane 14 first used as a mask by using this photoresist pattern as a mask as shown in a view 3 (2) is **********ed. When **********ing an insulator layer 2 by the dry method, it is an effective method to use the ion-beam-etching method using O2 gas for **********ing PIQ which is an organic film in order to improve pattern precision. As a metal membrane 14 as mask material at this time, various kinds of metals, such as high chromium of oxygen-proof ion-beam-etching nature, molybdenum, and nickel, can be used. Thus, by forming

a slot 20 in an insulator layer using the O2 gas-ion beam etching method, as shown in a view 3 (3), after forming a metal membrane pattern, and removing the metal membrane of the photoresist which remained after that, and mask material, as shown in a view 3 (4), a slot is formed on an insulator layer. Next, as shown in a view 4, a coil is formed into the slot formed on PIQ. How to form the metal membrane of a coil with electroplating is described. As shown in a view 4 (1), the plating ground film 4 is formed all over an insulator layer top from PIQ in which the slot was formed. a plating ground film -- PIQ and a conductor -- since adhesion with the metal membrane used as a coil is bad, it prepares in order to paste up a metal membrane on PIQ through a plating ground film On PIQ (substrate), vacuum evaporationo is carried out, for example using the sputtering method, then this plating ground film forms Cu for Cr on Cr by [which is a vacuum deposition / which is a vacuum deposition] carrying out vacuum evaporationo, for example using the sputtering method. at this time, Cr pastes up PIQ and Cu -- making -- moreover, Cu -- Cr and a conductor -- it is for pasting up the metal membrane used as a coil Ti, nickel, Mo, Ta, etc. besides Cr can be used as a former thing among plating ground films. Moreover, nickel, Au, etc. besides Cu can be used as a latter thing among plating ground films. this plating ground film top -- a conductor -- a metal, for example, Cu, is electroplated You may be Au and nickel besides Cu. As compared with the level difference of the slot 20 on the PIQ, irregularity of the front face of a metal membrane 5 can be made small by the covering power of this plating film (Cu film) at the time of a metal membrane 5, i.e., plating film formation. Next, etchback of this whole plating film is carried out. That is, the whole metal surface is **********ed until the insulating-layer front face 23 appears, as shown in a view 4 (3), between coils is insulated, and flattening of the front face is made to be carried out. Finally a PIQ film is formed in a front face, and formation of a coil pattern is finished. Since flattening of between the coil upper surface and the insulating-layer front faces 23 is carried out at this time, the front face of PIQ formed in the upper part can prevent degradation of the magnetic properties of the magnetic film which is formed evenly and formed on it at a back process. The etchback method shown in the view 4 (3) is explained below. As etchback by the dry method, sputter etching or the ion-beam-etching method is used. The dirty bag method is **********ing and retreating the whole surface, after forming a metal membrane front face until it became flat as explained in the view 4. However, in order to form a metal membrane until metal membrane 5 front face becomes flat, it is necessary to form a metal membrane thickly. There is a method shown in a view 5 as a method which does not need to thicken a metal membrane. That is, as shown in the 5th view (1), the front face of the coil embedded at the insulator layer as by ******'s also carrying out laminating formation of the fluid good organic resin 17 on it, carrying out flattening of the whole surface as shown in a view 5 (2), and carrying out etchback of the whole surface after that showed to a view 5 (3) in the irregularity of metal membrane 5 front face can be made evenly. In order to imprint the flat nature of the applied organic resin to coil formation as it is at this time, it is good to make equivalent the etch rate of an organic resin and a metal membrane. For example, the etch rate using PIQ as an insulator layer is explained, using Cu as a metal membrane. The difference of the etch rate of Cu and PIQ at the time of using the mixed gas of an argon and oxygen as the ion-beam-etching method and reactant gas is shown in a view 6. According to the view 6, the etch rate of PIQ can increase, the etch rate of Cu can fall, and the etch rate of Cu and PIQ can be set constant as the amount of oxygen increases. By selecting such conditions, the front face

after etchback can be made flat. How to grind mechanically can also be considered as other methods other than the etchback method. for example, the thing polished until the insulating-layer front face 23 appears also in respect of a surface irregular metal as a metal membrane front face is made flat by polishing a substrate front face as shown in a view 7 (2), and further shown in a view 7 (3) as shown in a view 7 (1) -- a conductor -- a coil 24 can be completed According to this method, it is effective in the increase and manufacturing-cost quantity of the number of processes by using vacuum devices, such as the dry method, being avoidable. Although this example described above described the example which used the organic resin as an insulator layer 2, an inorganic film can be used by selecting the etching method used for the etching conditions and etchback which form a slot similarly. Other methods are possible although electroplating was used as a method of forming a metal membrane 5 as shown in the view 4. for example, it is shown in a view 8 -- as -- chemical plating -- a metal membrane 5 -- forming -- a conductor -- it is possible to form a coil 24

As shown in a view 8 (1), activation for forming an electroless plating film in the whole front face of the insulator layer 2 in which the slot 20 was formed is given. An example of this processing is shown below. SnCl2.2H2O 40g/**HCl PdCl2.2H2O after dipping in the solution of 20ml / ** for 2 minutes 0.4g/**HCl By dipping in the solution of 4ml / ** for 2 minutes, Pd25 is deposited all over the front face of an insulator layer 2. Here, although activation which deposits Pd was carried out, metals, such as Au, Ag, and Pt, can be used for others. Thus, by dipping the substrate which gave activation into chemistry copper-plating liquid, it is possible to form the copper-plating film 5 all over the insulator layer front face where activation was given. Of course, it is possible not only chemistry copper plating but to use what metals, such as not only copper but gold, nickel, etc., if it is the metal which is electroless plating.

if it is not necessary to form the terminal for giving the electrical and electric equipment on a substrate like electroplating according to this method and activation is carried out -- what portion -- a conductor -- it is possible to form a coil Moreover, as other methods, there is a method using a vacuum deposition method or the sputtering method as described above. When this method is used, since it does not become small like [in the case of the above-mentioned galvanizing method], as for the irregularity on the front face of an insulator layer, it is desirable to take the method of carrying out flattening by the organic resin as an etchback method, as the view 5 showed. [Effect of the Invention] according to this invention -- a conductor with the high-density thin film magnetic head -- in case a coil is formed, therefore, the fall of the reliability of the magnetic head can be prevented to prevent that air bubbles are incorporated between coils in an insulator layer Furthermore, since irregularity of the front face of the insulator layer formed on a coil can also be made small, degradation of the magnetic properties of the magnetic film formed on it at a back process can be prevented, and it has the effect that the improvement in the property of the thin film magnetic head and the improvement in reliability by which densification was carried out can be attained at a simple process.

CLAIMS

(57) [Claim(s)] [Claim 1] The photoresist of the same pattern as a coil is formed. a substrate

top -- an insulator layer -- forming -- the aforementioned insulator layer top -- the conductor of a predetermined configuration -- The slot of the same pattern as a coil is formed. the aforementioned photoresist -- mask material -- carrying out -- the dry etching method -- the insulator layer top concerned -- the above -- a conductor -- Remove the aforementioned photoresist and a metal membrane is formed by the galvanizing method the whole surface on the aforementioned insulator layer including aforementioned Mizouchi. the front face of the aforementioned metal membrane -- the etchback method or grinding mechanically -- metal membranes other than Mizouchi -- removing -- Mizouchi -- the conductor of a predetermined configuration -- a coil -- forming -- the conductor concerned -- the manufacture method of the thin film magnetic head which forms the 2nd insulator layer on the aforementioned insulator layer which has a coil

[Translation done.]